Remarks

Claims 1 and 30 have been amended to specify that the cavities have flat bottom surfaces, claim 10 has been amended to independent form, and claim 32 has been amended to include limitations of claim 33. Claims 4 and 33 have been amended in view of the amendments to claims 1 and 32, respectively.

Allowable Subject Matter

As an initial matter, the allowance of claims 25-29 and the indication of allowable subject matter in claims 10-28 is greatly appreciated.

Information Disclosure Statement

Submitted concurrently herewith is an Information Disclosure Statement with a copy of U.S. Patent No. 3,706,998 to Hatcher, et al., (referred to from this point forward as "Hatcher") of which the undersigned became aware through an international search report in connection with a related application.

Hatcher discloses a phased array antenna 10 having a mounting plate 22 with a plurality of apertures therein of different sizes for supporting two or more groups of radiating elements 18 and 20. The radiating elements are disposed in an interleaved configuration, whereby each group of radiating elements 18 and 20 "has approximately the same control of the beamwidth and the steering of its beam of radiation as would be the case if only one of these groups were present." (Hatcher, abstract, see also, FIGS. 1-3.) "Each of the radiating elements 18 and 20 provides the dual function of reflecting and imparting a phase shift to the incident radiation." (Hatcher, col. 7, lines 59-62.) "The amount of phase shift is controlled by computer-generated signals, not shown, applied to each of the radiating elements." (Hatcher, col. 4, lines 16-18.)

Objections

Claims 10-18 are objected to as being dependent upon a rejected base claim. In view of the amendment of claim 10 to independent form, withdrawal of the objections and allowance of the claims is requested.

Rejections under 35 U.S.C. §103

Claims 1-9, 19-24 and 30-33 have been rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 2,528,852 to DeVore (referred to from this point forward as "DeVore").

DeVore discloses a lens for focusing radio waves having metal vanes 16 the spaces between which, and boundary plates 25 and 27, define paths 17. The vanes generally are spaced apart more or less than one half of a wavelength, and have increasing length in accordance with a predetermined formula. The resulting lens has paths with increasing length in proportion to the distance from a central path. The length of each path determines a shift in phase imposed on an incident wave upon passage through the lens. The outlet surface of the lens has a curvature of radius Rf, as shown in FIGS. 1-4 of DeVore, to direct incident radiation (traveling along path 15, for example, from incident wavefront 11) toward a focal point 7. FIG. 6 in DeVore shows notches cut into the end of each vane to cancel reflections.

DeVore fails to disclose a conductive surface with a plurality of discrete cavities therein each of which has a flat bottom surface. In contrast, the paths 17 disclosed in DeVore pass completely through DeVore's lens, and it is respectfully submitted that no teaching or suggestion of reflecting electromagnetic energy toward a focal point has been found. In fact, DeVore suggests cutting notches in the vanes at an end of each path to cancel reflections, which teaches away from the present invention. Furthermore, in the lens described in DeVore, phase shifts are due primarily to the different lengths of the paths through the lens whose accommodation requires the curved surface that the present invention eliminates.

It is respectfully submitted that the claimed invention would not have been obvious to a person of ordinary skill in the art in view of DeVore because there simply is no reason provided by DeVore for doing what the Applicant claims; namely, inducing a local phase shift in a reflected wavefront as a function of a selected dimension of a cavity having a flat bottom surface. DeVore does not reflect an incident wave, but rather passes the wave and focuses the energy on a focal point. Withdrawal of rejection is requested.

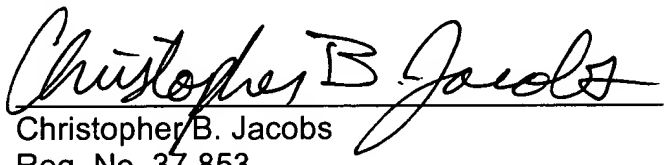
Conclusion

In view of the foregoing, the present application is believed to be in a condition for allowance and an early indication to that effect is earnestly solicited.

Should a petition for an Extension of Time be necessary for the timely reply to the outstanding Office Action (or if such a petition has been made and an additional extension is necessary) petition is hereby made, and the Commissioner is authorized to charge any fees (including additional claim fees) to Deposit Account No. 18-0988, under Attorney Docket No. RAYTP0161US.

Respectfully submitted,

RENNER, OTTO, BOISSELLE & SKLAR, LLP



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CERTIFICATE OF MAILING (37 CFR 1.8a)

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, U.S. Patent and Trademark Office, Washington, D.C. 20231.

January 7, 2003
Date

Christopher B. Jacobs

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Appendix B

Version with Markings to Show Changes Made

Please amend the application in the following manner.

In the Claims:

Please amend the claims as shown in the following numbered paragraphs.

1. (Amended) A wavefront transformer suitable for transforming an incident electromagnetic wavefront having a given shape to a reflected wavefront having a different shape, comprising: a substrate having a conductive surface for reflecting the incident electromagnetic energy, and a plurality of openings in the conductive surface, each opening formed by a respective one of a plurality of discrete cavities extending from the conductive surface and having a flat bottom surface, each cavity having a selected position on the conductive surface with respect to the focal point to induce a propagation phase shift over the distance to the focal point, each cavity inducing a local phase shift in the reflected electromagnetic energy as a function of a selected dimension of the cavity, the combined propagation phase shift and local phase shift from the plurality of cavities places the reflected electromagnetic energy in phase at the focal point.

4. (Amended) A wavefront transformer as set forth in claim 2, wherein the plate includes a first plate overlying a second plate, wherein the first plate has a plurality of through-holes therein that form the cavities and the second plate forms [a] the flat bottom surface of the cavities.

10. (Amended) A wavefront transformer [~~as set forth in claim 1~~] suitable for transforming an incident electromagnetic wavefront having a given shape to a reflected wavefront having a different shape, comprising: a substrate having a conductive

surface for reflecting the incident electromagnetic energy, and a plurality of openings in the conductive surface, each opening formed by a respective one of a plurality of discrete cavities extending from the conductive surface, each cavity having a selected position on the conductive surface with respect to the focal point to induce a propagation phase shift over the distance to the focal point, each cavity inducing a local phase shift in the reflected electromagnetic energy as a function of a selected dimension of the cavity, the combined propagation phase shift and local phase shift from the plurality of cavities places the reflected electromagnetic energy in phase at the focal point, wherein only the positions of the cavities and the selected dimension of the cavities varies, the dimension of each cavity is selected such that the total phase shift at the focal point of an electromagnetic wave reflected from each cavity is equal, so that

$$\phi(r) = \phi(0) + \frac{2\pi}{\lambda}\left(\sqrt{r^2 + f^2} - f\right),$$

where r is the distance of the cavity from a reference point in the plane of the conductive surface, $\phi(r)$ is the local phase shift imposed on an incident electromagnetic wave at r by the flat reflecting surface, f is the focal length of the reflector, λ is a desired wavelength of the reflected electromagnetic energy, and $\phi(0)$ is the local phase shift imposed on an incident electromagnetic wave by a cavity at the reference point having a dimension a(0,0).

30. (Amended) An antenna suitable for focusing incident electromagnetic energy at an operating wavelength on a focal point, comprising: a geometrically flat wavefront transformer plate having a conductive surface and a waveguide feed positioned at the focal point suitable to receive the reflected electromagnetic energy; the wavefront transformer plate further includes a plurality of discrete cavities opening in the conductive surface and having a flat bottom surface, the dimensions of each cavity varying as a function of the position of the cavity on the plate with respect to the

focal point to induce a local phase shift on the incident wave of electromagnetic energy as the electromagnetic energy is reflected, the cavities being spaced with respect to adjacent cavities to enable the wavefront transformer plate to focus the reflected electromagnetic energy at the focal point such that electromagnetic energy reflected from the wavefront transformer plate is in phase at the focal point.

32. (Amended) A reflector suitable for focusing incident electromagnetic energy at an operating wavelength on a focal point, comprising: means for focusing an incident plane wave of any polarization at the focal point using constructive interference that includes a substrate having a conductive surface for reflecting incident electromagnetic energy, and a plurality of closed-end cavities having openings in the conductive surface.

33. (Amended) A reflector as set forth in claim 32, wherein [~~the means for focusing includes a substrate having a conductive surface for reflecting the incident electromagnetic energy, and a plurality of discrete cavities having openings in the conductive surface,~~] each cavity forms [~~forming~~] part of at least one equilateral-triangular arrangement of cavities.